REMARKS

In response to the Office Action mailed February 22, 2002, Applicants respectfully request reconsideration. To further the prosecution of this application, the objections and rejections set forth in the Office Action have been considered, and each is responded to below.

Claims 1-31 and 33-96 are pending in this application, of which 1, 7, 16, 25, 30, 38, 66, and 87 are independent claims. In this amendment, the specification and drawings have been amended, claim 32 has been cancelled, claims 1-3, 7, 16, 25, 30, 31 and 34 have been amended, and claims 38-96 have been added. The application as now presented is believed to be in condition for allowance.

I. Oath/Declaration

In ¶1 of the Office Action, the oath or declaration is deemed defective. Applicants submit herewith an Application Data Sheet, pursuant to 37 C.F.R. §1.76, that addresses the deficiencies noted in the Office Action by specifying the citizenship, residence and postal address of each inventor.

II. Objections to the Specification

In ¶2 of the Office Action, the disclosure is objected to as using the reference character "13" to designate both a single LED and multiple LEDs. To address this issue, Applicants have amended the specification in various locations to refer to "one or more LEDs 13" where appropriate. Thus, the reference character 13 now more clearly designates a single LED. Accordingly, Applicants respectfully request that this objection be withdrawn.

In ¶3 of the Office Action, the disclosure is objected to as containing an informality at line 5 of page 7. In particular, the Examiner notes that "a memory mechanism 16" is designated with the wrong reference character and should read -- a memory mechanism 17 --. The informality has been corrected in accordance with the Examiner's suggestion.

In ¶4 of the Office Action, the disclosure is objected to as containing an informality at line 11 of page 9. In particular, the Examiner notes that "a memory chip 16" is improperly

designated, and that the objection may be obviated by deleting "a memory chip 16" and inserting -- a memory mechanism 17, such as a memory chip --. The informality has been corrected in accordance with the Examiner's suggestion.

In ¶5 of the Office Action, the disclosure is objected to as containing an informality at line 25 of page 9. In particular, the Examiner notes that the phrase "if the has been" is grammatically incorrect. The informality has been corrected by deleting "the has" and inserting -- there had --.

In ¶6 of the Office Action, the disclosure is objected to as containing an informality at lines 17-19 of page 10. In particular, the Examiner notes that the phrase "the photosensor 14" should read -- the photosensor 43 --. The informality has been corrected in accordance with the Examiner's suggestion.

III. Objections to the Drawings

In ¶7 of the Office Action, the drawings are objected to as not showing every feature of the invention specified in the claims. In particular, the Examiner asserts that the "multiple LEDs" must be shown or the feature(s) cancelled from the claims. Figure 6 has been amended to designate both illumination source 62 and one or more LEDs 13. Further, Applicants note that Figure 1 illustrates multiple LEDs which, for the sake of clarity, have been individually designated with the reference character "13" via the amendment to Figure 1. Accordingly, Applicants respectfully request that this objection be withdrawn.

In ¶s 8-11 of the Office Action, the drawings are objected to as failing to comply with 37 C.F.R. §1.84(p). In particular, in ¶8, the Examiner indicates that the support 12, the LED 13, the memory mechanism 17, and the opening 18 are indistinguishable in the present drawings. Formal drawings have been prepared and submitted to the Official Draftsperson under separate cover, and are believed to both address the noted concerns and comply with 37 C.F.R. §1.84(p) (a copy of the formal drawings as filed is attached here for the Examiner's reference). Accordingly, Applicants respectfully request that that the various objections to the drawings be withdrawn.

IV. Objections to the Claims

In ¶12 of the Office Action, claim 2 is objected to as containing an informality. In particular, the Examiner notes that "the support is can accommodate" is grammatically incorrect. The informality has been corrected by deleting "is," in accordance with the Examiner's suggestion.

In ¶13 of the Office Action, claim 34 is objected to as containing an informality. In particular, the Examiner notes that the recited "relative value" lacks antecedent basis. The informality has been corrected by changing the dependency of claim 34 from claim 30 to claim 33, in accordance with the Examiner's suggestion.

V. Rejections of the Claims Over Eberly Under 35 U.S.C. §102(b)

In ¶14 of the Office Action, claims 1, 2, 7, 8, 12, 13, 15-17, 21-27, and 29-31 and 33-35 are rejected under 35 U.S.C. §102(b) as allegedly being anticipated by Eberly (U.S. Patent No. 5,073,029). Applicants respectfully traverse these rejections.

A. Discussion of Eberly

Eberly is directed to a system for obtaining sequential optical density (absorbance) measurements of a plurality of biological/chemical solution samples (Abstract). In the system of Eberly, each sample is associated with one LED located on one side of the sample to irradiate the sample (Col. 4, lines 31-34). When radiation from the LED passes through the sample, it is partially absorbed (Col. 4, lines 34-36). A photodetector on an opposite side of the sample detects radiation that is transmitted through the sample, and provides an output signal from which absorbance data can be obtained (Col. 4, lines 36-50). Hence, it should be appreciated that the radiation produced by an LED in the system of Eberly is not intended as light to be observed by an observer or to significantly illuminate a space, but rather merely is intended to irradiate a sample in a closed environment to obtain scientific data.

In the system of Eberly, it is important that each LED be driven by a precision current source to provide a precision light pulse output so that consistent absorbance measurements may be obtained (Col. 7, lines 27-30). Specifically, any imprecision or instability in the current

source directly affects the light pulse generated by an LED to irradiate a sample; accordingly, a current stability of greater than 0.1% is necessary to enable the system of Eberly to accurately measure the absorbance of a given sample to one part per thousand (Col. 7, lines 32-35). In a preferred embodiment of the system of Eberly, each LED therefore receives a precision constant current of 20 milliamperes (Col. 7, lines 38-40). Accordingly, it should be appreciated that in the system of Eberly, the current input signal to each LED is not varied; in contrast, an identical, precise and constant current is sequentially applied to each LED of the system.

Notwithstanding the application of an identical and precise current to each LED, the respective LEDs in the system of Eberly typically generate different amounts of luminous intensity, due to fabrication and response inconsistencies, for example (Col. 7, lines 59-61). Similarly, the respective photodetectors typically vary in sensitivity and dark current output, again due to fabrication and response inconsistencies (Col. 7, lines 63-66). Accordingly, the system of Eberly implements a normalization algorithm to process the respective output signals of the LED/photodetector pairs so as to account for naturally-occurring variances in these output signals that are not due to sample differences (Col. 7, lines 66-68).

Specifically, on power-up, the system of Eberly first determines and stores a mathematical relationship (normalization equation) for each LED/photodetector pair, which is subsequently applied to the respective output signals of the photodetectors to provide accurate absorbance measurements (Col. 9, lines 54-60). These normalization equations are first derived for each LED/photodetector pair without an intervening sample by measuring the photodetector output signal with the LED turned on (i.e., representing a theoretical 100% transmittance), and subtracting the photodetector output signal with the LED turned off (i.e., representing a theoretical 0% transmittance) (Col. 9, lines 23-32).

Subsequently, when samples are placed between the LED/photodetector pairs in the system of Eberly, each photodetector output signal is scaled using a corresponding normalization equation. The respective normalization equations may be applied to the photodetector output signals either via a programmable attenuation stage following the photodetectors (Col. 8, lines 1-10), or via a microprocessor that executes a program to process the outputs of analog-to-digital

converters which convert the photodetector output signals from analog values to digital values (Col. 9, lines 50-57).

In sum, Eberly teaches only that respective LEDs are sequentially turned on one at a time by applying an identical, precise, constant current to each LED. Accordingly, Eberly does not disclose or suggest calculating or otherwise determining a calibration value for one or more LEDs, nor does Eberly disclose or suggest changing the input signal to an LED, based on a calibration value, to cause the LED to output a calibrated intensity.

Rather, to the extent that Eberly discusses "calibration," it is to achieve a normalized data value by processing an electrical output signal of an LED/photodetector pair, and not by affecting an LED input signal to any extent or changing the light output of an LED based on a calibration value. Specifically, the LEDs in the system of Eberly do not output calibrated intensities, but instead receive identical constant input signals and output respectively different *uncalibrated* intensities. Hence, it is the electrical output signals of the photodetector, and not the intensity of the LEDs, that is normalized in the system of Eberly; again, it should be appreciated that the LEDs of Eberly output respectively different *uncalibrated* intensities.

B. Applicants' Claims Patentably Distinguish over Eberly

Claims 1-6

Applicants' claim 1, as amended, is directed to a system for calibrating light output by a light-emitting diode (LED). The system of claim 1 comprises a housing to which an LED to be calibrated may be positioned therein and a photosensor disposed in the housing for obtaining an output measurement generated by the LED. The system also comprises a processor in communication with the photosensor and the LED, wherein the processor is configured to formulate a calibration value based on a comparison of the output measurement and a reference value, such that during a subsequent generation of light output, the calibration value permits the subsequent light output to have a calibrated intensity. The system further comprises a memory mechanism in association with the LED to store the calibration value.

Eberly does not disclose or suggest the system of Applicants' claim 1. In particular, Eberly does not disclose or suggest a processor configured to formulate a calibration value based

on a comparison of an LED generated output measurement and a reference value, such that during a subsequent generation of light output, the calibration value permits the subsequent light output to have a calibrated intensity, as recited in claim 1. Rather, as discussed above, Eberly merely discloses that the electrical output signals of the photodetector, and not the intensity of the LEDs, are normalized; more specifically, Eberly's LEDs output respectively different *uncalibrated* intensities.

The Office Action cites lines 6-17 of column 9 of Eberly as allegedly anticipating the processor of claim 1. Applicants respectfully disagree. This cited passage of Eberly only discloses an "attenuator checksum" algorithm to confirm that attenuator constants for each LED/photodetector pair have been properly written to an attenuator table in memory. The checksum is performed to detect the presence of errors (e.g., caused by a system crash), and thereby enable the attenuator table to be rebuilt in the event of an error. The checksum algorithm does not calculate any values used for calibration. Thus, the cited passage does not teach or suggest a processor configured to formulate a calibration value, as recited in claim 1.

For at least the foregoing reasons, claim 1 patentably distinguishes over Eberly and is in condition for allowance. Therefore, the rejection of claim 1 under 35 U.S.C. §102(b) as allegedly being anticipated by Eberly should be withdrawn.

Claims 2-6 depend from claim 1 and are respectfully believed to be allowable for at least the same reasons. Accordingly, for the sake of brevity, Applicants believe that it is unnecessary at this time to argue the allowability of each of the dependent claims individually. However, Applicants do not necessarily concur with the interpretation of the dependent claims as set forth in the Office Action, nor do Applicants concur that the basis for the rejection of any of the dependent claims is proper. Therefore, Applicants reserve the right to specifically address the patentability of the dependent claims in the future, if deemed necessary.

Claims 7-15

Claim 7, as amended, is directed to a calibration device comprising a support to which an LED to be calibrated may be positioned thereon, and a photosensor adjacent to the support for obtaining an output measurement from the light output generated by the LED. The device of

claim 7 further comprises a communication mechanism through which the output measurement from the photosensor is communicated to a processor, which processor formulates a calibration value based on a comparison of the output measurement and a reference value, and through which the calibration value from the processor is communicated to the LED. Claim 7 further recites that the LED includes a memory mechanism on which the calibration value communicated from the processor is stored.

Eberly does not disclose or suggest the device of Applicants' claim 7. In particular, Eberly does not disclose or suggest a communication mechanism through which a calibration value from a processor is communicated to an LED, nor does the Office Action cite any passage of Eberly as providing such a teaching. As noted in the discussion of Eberly above, normalization is performed in Eberly by processing output signals from a photodetector, while the generation of light by the LEDs is unaffected in Eberly. Thus, Eberly not only fails to teach or suggest a communication mechanism through which a calibration value is communicated to an LED, but also discloses a system wherein such a communication mechanism would simply be of no value, as the LEDs in Eberly are not adjusted in any manner.

For at least the foregoing reasons, claim 7 patentably distinguishes over Eberly and is in condition for allowance. Therefore, the rejection of claim 7 under 35 U.S.C. §102(b) as being anticipated by Eberly should be withdrawn.

Claims 8-15 depend from claim 7 and are allowable for at least the same reasons. Accordingly, as discussed above, Applicants believe that it is unnecessary at this time to argue the allowability of each of the dependent claims individually and reserve the right to specifically address the patentability of the dependent claims in the future, if deemed necessary.

Claims 16-24

Applicants' claim 16, as amended, is directed to a calibration device comprising a housing, an activation unit for inducing light output from an LED to be calibrated, and a photosensor at one end of the housing for obtaining an output measurement from the light output generated by the LED. The device of claim 16 further comprises a communication mechanism in the housing through which the output measurement from the photosensor is communicated to

a processor, which processor formulates a calibration value based on a comparison of the output measurement and a reference value, and through which the calibration value from the processor can be received by the device and subsequently communicated to the LED.

As discussed in connection with independent claim 7, Eberly does not disclose a communication mechanism through which a calibration value from the processor is communicated to an LED. For at least this reason, claim 16 patentably distinguishes over Eberly and is in condition for allowance. Therefore, the rejection of claim 16 under 35 U.S.C. §102(b) as being anticipated by Eberly should be withdrawn.

Claims 17-24 depend from claim 16 and are allowable for at least the same reasons. Accordingly, as discussed above, Applicants believe that it is unnecessary at this time to argue the allowability of each of the dependent claims individually and reserve the right to specifically address the patentability of the dependent claims in the future, if deemed necessary.

Claims 25-29

Applicants' claim 25, as amended, is directed to an illumination device comprising a housing, an LED illumination source positioned within the housing, and a photosensor within the housing and adjacent to the illumination source for obtaining an output measurement generated by the LED. The device of claim 25 further comprises a processor within the housing and in communication with the photosensor for making a comparison of the output measurement received from the photosensor and a reference value and formulating a calibration value based on the comparison. The device further comprises a memory mechanism coupled to the LED illumination source and on which the resulting calibration value from the processor is stored.

Eberly does not disclose an illumination device that includes a processor to formulate a calibration value, as recited in claim 25, nor does the Office Action cite any passage as supporting this teaching. As noted above in the discussion of Eberly and in connection with independent claim 1, Eberly does not disclose or suggest a processor configured to formulate a calibration value based on a comparison of an LED generated output measurement and a reference value. Rather, as discussed above, Eberly merely discloses that the electrical output signals of the photodetector, and not the intensity of the LEDs, are normalized.

For at least this reason, claim 25 patentably distinguishes over Eberly and is in condition for allowance. Therefore, the rejection of claim 25 under 35 U.S.C. §102(b) as being anticipated by Eberly should be withdrawn.

Claims 26-29 depend from claim 25 and are allowable for at least the same reasons. Accordingly, as discussed above, Applicants believe that it is unnecessary at this time to argue the allowability of each of the dependent claims individually and reserve the right to specifically address the patentability of the dependent claims in the future, if deemed necessary.

Claims 30-37

Applicants' claim 30, as amended, is directed to a method for calibrating light output by a light-emitting diode (LED). The method comprises acts of a) generating light output from the LED in a substantial absence of ambient light, b) obtaining an output measurement for the light output generated by the LED, c) comparing the output measurement to a reference value, and d) formulating a calibration value based on the act c), such that during a subsequent generation of light output, the calibration value permits the subsequent light output to have a calibrated intensity.

As discussed in connection with independent claim 1, neither the passage cited at lines 6-17 of column 9 nor any other portion of Eberly discloses formulating a calibration value that permits light output from an LED to be adjusted in any way. Thus, Eberly does not teach at least the acts c) and d) as recited in claim 30.

For at least this reason, claim 30 patentably distinguishes over Eberly. Therefore, the rejection of claim 30 under 35 U.S.C. §102(b) as being anticipated by Eberly should be withdrawn.

Claims 31-37 depend from claim 30 and are allowable over Eberly for at least the same reasons. Accordingly, as discussed above, Applicants believe that it is unnecessary at this time to argue the allowability of each of the dependent claims individually and reserve the right to specifically address the patentability of the dependent claims in the future, if deemed necessary.

VI. Rejections of the Claims Over Lebens Under 35 U.S.C. §102(b)

In ¶15 of the Office Action, claims 30, 36, and 37 were rejected under 35 U.S.C. §102(b) as allegedly being anticipated by Lebens (U.S. Patent No. 6,095,661). Applicants respectfully traverse these rejections.

Lebens is directed to a flashlight that includes a control circuit to regulate the light output of LEDs as a voltage of an electric power source of the flashlight (e.g., a battery) varies (Abstract). In particular, with reference to Lebens various figures, a power supply and control circuit 130 may apply electrical power from battery 120 to LEDs 150 based on feedback relating to the light output of the LEDs 150 (Col. 7, lines 53-59). As shown in Fig. 2 of Lebens, drive signals 250 output by the microprocessor 134, which controls the light output by the LEDs 150, are adjusted based on a feedback signal 260 derived from the light output of the LEDs so as to maintain a predetermined light output level of the LEDs as a charge on the battery varies (i.e., as battery voltage declines and power is drained (Col. 7, line 53; Col. 8, lines 43-46). In one embodiment of Lebens, a lookup table 234 is used by the microprocessor 134 to convert the feedback signal 260 to digital values used to control the drive signals 250 so as to maintain the predetermined light output level (Col. 8, lines 46-49).

In sum, Lebens teaches that the light output of LEDs may be regulated (as opposed to "calibrated") at a predetermined value in spite of changes (i.e., decreases) in a battery voltage as power is drained from the battery. However, nowhere does Lebens teach or suggest calculating, formulating, or otherwise determining a calibration value that is used to control an LED to output various calibrated intensities. In particular, it is noteworthy that nowhere in the reference does Lebens use the word "calibration," nor does Lebens otherwise refer to or make mention of "calibration" of any kind; rather, the system of Lebens clearly is directed to power *regulation* of LEDs, and not to calibration.

With respect to Applicants' claim 30, the Office Action cites Lebens at lines 46-49 of column 8 as allegedly anticipating act (d) of claim 30. Applicants respectfully disagree. This passage, discussed in the summary of Lebens above, teaches that a signal to be applied to an LED may be selected using a lookup table, based on feedback from the LED. However, Lebens does not teach formulating a calibration value that permits light output to have a calibrated

intensity, as recited in claim 30. Rather, Lebens teaches only that the light output of LEDs may be regulated to a predetermined value based on a feedback loop, which regulation process is different than calibration (i.e., producing an output that is related to an input in a known, predetermined manner).

For at least this reason, claim 30 patentably distinguishes over Lebens. Therefore, all rejections of claim 30 having now been addressed, the rejection of claim 30 under 35 U.S.C. §102(b) should be withdrawn.

Claims 31-37 depend from claim 30 and are allowable for at least the same reasons.

VII. Rejections of the Claims Under 35 U.S.C. §103(a)

In ¶16 of the Office Action, claims 3, 4, 14, and 28 are rejected under 35 U.S.C. §103(a) as allegedly being obvious over Eberly. In ¶20 of the Office Action, and claims 5, 6, 9-11, and 18-20 are rejected under 35 U.S.C. §103(a) as allegedly being obvious over Eberly in view of Parker (McGraw-Hill Dictionary of Scientific and Technical Terms). Since claims 3-6, 9-11, 14, 18-20, and 28 are believed to be allowable on the basis of their dependency, Applicants believe that it is unnecessary at this time to address the merits of the rejection of these claims. Accordingly, Applicants respectfully reserve the right to specifically address the claim rejections under 35 U.S.C. §103(a) in the future, if deemed necessary.

VIII. New Claims

Claims 38-96, including independent claims 38, 66, and 87, are added to further define and clarify Applicants' contribution to the art. No new matter is added.

In particular, support for the various features and concepts recited in new claims 38-96 may be found throughout the specification as well as the priority document, Serial No. 60/156,672. For example, a "lighting device" is specifically discussed in the specification at least on pages 14-15. The concept of mixing colors is discussed generally in the specification at least one page 2, lines 12-15, page 8, lines 1-13, and in the priority document. The concept of mixing colors to produce white light also is discussed in the specification on page 8, line 6, and in the priority document. Additionally, the various features and functions relating to calibration,

as recited in the new claims, are discussed, for example, at least on the top of page 3, on page 5, lines 21-23, and throughout pages 8-9 of the specification, as well as in the priority document. It is respectfully believed that one of ordinary skill in the art would readily understand and appreciate the recitations in the new claims, based on the teachings of the specification and the priority document, as clarifying and emphasizing various features of the disclosed inventions that are believed to be patentable and which further define Applicants' contribution to the art.

For example, new independent claims 38 and 66 respectively are directed to a lighting device and a lighting method to generate light having a single calibrated color at a given time formed by mixing a first color and at least one second color different from the first color, wherein the single calibrated color has an intensity sufficient to significantly illuminate a space. None of the references of record disclose or suggest such an apparatus or method. Accordingly, newly added independent claims 38 and 66 and the claims depending therefrom respectfully are believed to be in allowable condition.

New independent claim 87 is directed to a lighting device, comprising a plurality of high-intensity LEDs adapted to generate an additive mixture of colored light to illuminate a space, and calibration means for adjusting the light output of at least some LEDs of the plurality of high-intensity LEDs such that the additive mixture of colored light has a calibrated color. None of the references of record disclose or suggest such a lighting device. Accordingly, newly added independent claim 87 and the claims depending therefrom respectfully are believed to be in allowable condition.

Conclusion

In view of the foregoing amendments and remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this amendment, that the application is not in condition for allowance, the Examiner is requested to call the Applicants' attorney at the number listed below to discuss any outstanding issues related to the allowability of the application.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to deposit account No. 23/2825.

Respectfully submitted,
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the specification:

The paragraph beginning at line 29 of page 5 has been amended as follows:

Referring now to the drawings, in Fig. 1, there is shown a system 10 for calibrating light output from a light-emitting diode (LED). The system 10, in one embodiment, includes a support 12, on which [an LED 13 or multiple] one or more LEDs 13 to be calibrated may be positioned. The support 12 may also accommodate a module (not shown) with [multiple] one or more LEDs 13 therein, similar to those modules used in connection with various LED illumination devices. Such a module is disclosed in U.S. Patent No. 6,016,038, which is hereby incorporated herein by reference.

The paragraph beginning at line 5 of page 7 has been amended as follows:

The system 10 further includes a memory mechanism [16] 17 in association with the one or more LEDs 13, and on which the calibration value for use in adjusting the light output by the one or more LEDs 13 is stored. Memory mechanism 17 may be any commercially available memory mechanism having data storing capability. In one embodiment of the invention, the memory mechanism 17 is physically coupled to the one or more LEDs 13, so that once the calibration value has been stored thereon, the memory mechanism 17 can be removed from the support 12 along with the one or more LEDs 13. Upon subsequent generation of light output from the LED 13 in, for example, an illumination device, the calibration value on the memory mechanism 17 can be accessed to affect the output generated from the LED 13. In other words, the calibration value permits the light output from the LED to approximate light output accorded to a reference value for that type of LED.

The paragraph beginning at line 20 of page 8 has been amended as follows:

Referring now to Fig. 2, a process for calibrating light output is shown therein. Once the LED 13 is in position for calibration, as indicated in item 21, the LED 13 may be caused to generate a light output 22. If [multiple] one or more LEDs 13 are being calibrated, each LED in the group may be caused to generate light output in sequential fashion. As each LED 13

generates its light output, for example, red, green or blue, the photosensor 14 records, in step 23, a peak measurement from the light output, and assigns, in step 24, as a spectral response, a relative value for the peak measurement. As shown in Fig. 3A, the peak value for the light output can vary widely. In step 25, the peak value for each individual output may be compared to a reference value (e.g., within a table of reference [value] values) that had previously been established as representative for an LED of that type. If there are any differences between the peak value and the established reference value, the peak value for that individual output is adjusted, in step 26, by scaling that individual output to the reference value. The adjustment of the light output in this manner can result in the higher peaks being reduced (i.e., scaled) to match the value of the lower peaks, see Fig. 3B, to provide a uniform light output. It should be noted that several iterations (i.e., adjustments) may be needed to get an adjusted peak value that closely [resemble] resembles the reference value. Moreover, in a situation wherein calibration of a plurality of LEDs [13] is required, once calibration for one LED is completed, calibration for the next LED can be initiated.

The paragraph beginning at line 7 of page 9 has been amended as follows:

In adjusting the output, a calibration value may be formulated. The calibration value for the light output of each LED 13 may then be stored, in step 27. This calibration value, once stored, can replace previous calibration settings, if any, and can be employed in all future/subsequent generation of light output by the LED 13. Storage of the calibration value can be accomplished by providing the LED 13 with a memory mechanism 17, such as a memory chip [16] (see Fig. 1). In this manner, when commands are sent to the LED 13 for generating a light output, the stored calibration value for that particular LED may be accessed from the memory chip and used to permit the LED 13 to generate a light output which approximates a light output accorded to the reference value.

The paragraph beginning at line 25 of page 9 has been amended as follows:

The system 10 may also be used to determine if [the has] there have been any LED placement errors during the LED board assembly. In particular, a discrepancy between a measured color value and referenced color value may indicate that one or more of the LEDs may

have been placed improperly, e.g., a green LED in a red location or some other incorrect combination, during assembly.

The paragraph beginning at line 11 of page 10 has been amended as follows:

Looking now at Fig. 4, Fig. 4 illustrates, in accordance with an embodiment of the present invention, a device 40 for calibrating light output from a light-emitting diode. [The device 40.] The device 40 includes a support 41, to which an LED 42, for instance, newly manufactured, or from an illumination device (not shown), may be positioned thereon for calibration. The device 40 also includes a photosensor 43 adjacent to the support 41 for obtaining an output measurement generated by the LED. The photosensor 43 may be placed in any location relative to the LED 42, so long as the photosensor [14] <u>43</u> can receive the output by the LED 42. Accordingly, the location of the photosensor [14] <u>43</u> may be adjustable within the device 40, so that for example, the photosensor [14] <u>43</u> may be moved adjacent to the LED 42, or into substantial alignment with the LED 42.

The paragraph beginning at line 3 of page 12 has been amended as follows:

In Fig. 5, another calibration device 50 is provided, in accordance with an embodiment of the present invention. The device 50 is similar to the device 40, illustrated in Fig. 4, except that the device 50 can be configured to calibrate the light output of [an LED 52] <u>one or more LEDs 13</u>, without having to remove the [LED 52] <u>one or more LEDs 13</u> from the illumination device <u>52</u> within which the [LED 52 sits] <u>one or more LEDs sit</u>.

The paragraph beginning at line 8 of page 12 has been amended as follows:

The calibration device 50, as shown in Fig. 5, includes a housing 51 and a photosensor 53 at one end of the housing 51 for obtaining an output measurement from the light output generated by the [LED 52] <u>one or more LEDs 13</u>. The photosensor 53 may be affixed at one end of the housing 51, or may be adjustable to alter its position within the housing 51. As the [LED 52] <u>one or more LEDs 13</u> will remain within the illumination device <u>52</u> and will not be positioned on the device 50 during calibration, the calibration device 50 may be provided with an activation unit 54 for inducing light output from the [LED 52] <u>one or more LEDs 13</u>. To activate

the [LED 52] one or more LEDs 13 to generate alight output, the activation unit 54 may send a signal directed at the [LED 52] one or more LEDs 13. To this end, the illumination device 52 or the [LED 52 itself] one or more LEDs 13 themselves may be designed with the ability to receive the signal from the activation unit 54. The signal from the activation unit 54 can be sent by conventional cable or wirelessly. In the wireless embodiment, the device 50 may include a transmitter 55 coupled to the activation unit 54 to transmit the signal. Correspondingly, the illumination device 52 can be provided with a receiver (not shown) coupled to the [LED 52] one or more LEDs 13 to receive the signal transmitted from the activation unit 54.

The paragraph beginning at line 22 of page 12 has been amended as follows:

The calibration device 50 may also include a communication mechanism, such as a port 56, in the housing 51, similar to port 44 in device 40. In particular, the port 56 maybe designed to be in coupling communication with the photosensor 53, so that an output measurement from the photosensor 53 may be communicated to a processor 57 for formulation of a calibration value. The port 56 may also be designed so that data, such as the calibration value, from the processor 57 may be received by the device 50, and subsequently relayed to the [LED 52] one or more LEDs 13. The port 56 may employ conventional cables for communication or may employ wireless means, such as a transmitter or receiver, as described above. In one embodiment, the transmitter in connection with the port 56 and transmitter 55, used to transmit activation signals to the [LED 52] one or more LEDs 13, may be a single transmitter.

The paragraph beginning at line 1 of page 13 has been amended as follows:

The device 50, in one embodiment, may include a display 58, on which parameters regarding light output from the [LED 52] one or more LEDs 13 may be provided to inform a user of the status of the light output from the [LED 52] one or more LEDs 13. The device 50 may also be provided with an interface 59 to permit the user to vary light output and/or parameters for the [LED] one or more LEDs. The device 50 may also include a memory mechanism 591. The memory mechanism 591 may be used for storing the output measurement from the photosensor 53, as well as other light output parameters, all of which can subsequently be communicated to an off-site processor [55] 57 for calibration processing. In an alternate embodiment, the device

50 may incorporate the processor 57 within the device 50 to permit, for example, calibration to be carried out in a timely and efficient manner, without the need to communicate with an off-site processor.

The paragraph beginning at line 11 of page 13 has been amended as follows:

Looking now at Fig. 6, the present invention further provides an illumination device 60 which may be capable of self calibration. The device 60 may be similar to the module in U.S. Patent No. 6,016,038, and includes a housing 61, and an LED illumination source 62 including one or more LEDs 13 within the housing 61. A photosensor 63 may be positioned adjacent to the LED illumination source 62 to obtain an output measurement generated by the LED illumination source 62. The position of the photosensor 63 relative to the LED illumination source 62, in one embodiment, permits the photosensor 63 to uniformly [records] record the light output from the source 62.

The paragraph beginning at line 19 of page 13 has been amended as follows:

The device 60 may also include a processor 64 within the housing 61 and in communication with the photosensor 63 for calibrating the output measurement from the photosensor 63 against a reference value. The processor 64 may also be in communication with the LED illumination source 62 for transmitting thereto a resulting calibration value from the processor 64. This calibration value may be used to affect the light output of the source 62, such that the output approximates an output accorded to the reference value. In one embodiment, the calibration process may be part of a feedback loop where the processor 64 monitors the light output from the source 62 via a photosensor 63 and automatically communicates the calibration value to the illumination source 62 to permit the light output to [compensation] compensate for any changes.

The paragraph beginning at line 3 of page 14 has been amended as follows:

By providing the device 60 with the above components, the device 60 may be activated to self-calibrate periodically. For instance, parameters regarding the illumination source 62 may be reviewed on the display 65. Should the illumination source 62 require calibration, the interface

66 may be accessed and the calibration process initiated. Once the calibration is completed, and the illumination source 62 can now generate a light output that approximates, for example, a light output defined by the user by way of the interface [65] 66, the calibration ceases. In an embodiment of the invention, the device 60 may be designed to have the processor 64 initiate calibration, for instance, on a periodic basis, within certain predefined intervals, or in response to a particular condition, so that the light output from the illumination source 62 may be kept at a desired predefined level. Again, once calibration permits the illumination source 62 to achieve the desired light output level, the calibration ceases.

In the claims:

Claims 1-3, 7, 16, 25, 30, 31 and 34 have been amended as follows:

1. (Amended) A system for calibrating light output by a light-emitting diode (LED), the system comprising:

a [support] housing to which an LED to be calibrated may be positioned [thereon] therein;

a photosensor [adjacent to the support] disposed in the housing for obtaining an output measurement generated by the LED;

a processor in communication with the photosensor and the LED, the processor configured to formulate a calibration value [from and adjustment] based on a comparison of the output measurement [against] and a reference value, such that during a subsequent generation of light output, the calibration value permits the subsequent light output to [approximate an output accorded to the reference value] have a calibrated intensity; and

a memory mechanism in association with the LED[, and on which the resulting value from the calibration may be stored] to store the calibration value.

2. (Amended) A system as set forth in claim 1, wherein the [support is] housing can accommodate a fixture having multiple LEDs thereon.

3. (Amended) A system as set forth in claim 1, [further including] <u>wherein the housing is configured as</u> an enclosed member [configured] to encompass [the support, the memory mechanism, and] <u>at least</u> the photosensor, so as to <u>substantially</u> block ambient light from [therebetween and permit only measurement of the output from the LED] <u>reaching the photosensor</u>.

7. (Amended) A calibration device comprising:

a support to which an LED to be calibrated may be positioned thereon;

a photosensor adjacent to the support for obtaining an output measurement from the light output generated by the LED; and

a communication mechanism through which [an] <u>the</u> output measurement from the photosensor is communicated to a processor, which processor formulates a calibration value [from an adjustment] <u>based on a comparison</u> of the output measurement [against] <u>and</u> a reference value, and through which the calibration value from the processor is communicated to the LED;

wherein the LED includes a memory mechanism on which the calibration value communicated from the processor [may be] <u>is</u> stored.

16. (Amended) A calibration device comprising:

a housing;

an activation unit for inducing light output from an LED to be calibrated;

a photosensor at one end of the housing for obtaining an output measurement from the light output generated by the LED; and

a communication mechanism in the housing through which <u>the</u> output measurement from the photosensor is communicated to a processor, which processor formulates a calibration value [from an adjustment] <u>based on a comparison</u> of the output measurement [against] <u>and</u> a reference value, and through which the calibration value from the processor can be received by the device and subsequently communicated to the LED.

25. (Amended) An illumination device comprising:

a housing;

an LED illumination source positioned within the housing;

a photosensor within the housing and adjacent to the illumination source for obtaining an output measurement generated by the LED;

a processor within the housing and in communication with the photosensor for [calibrating] making a comparison of the output measurement received from the photosensor [against] and a reference value[, and with the LED for transmitting thereto a resulting calibration value from the processor] and formulating a calibration value based on the comparison; and

a memory mechanism coupled to the LED illumination source and on which the resulting calibration value from the processor [may be] is stored.

30. (Amended) A method for calibrating light output by a light-emitting diode (LED), the method comprising acts of:

a) generating light output from the LED in a substantial absence of ambient light;

b) obtaining an output measurement for the light output generated by the LED;

c) comparing the output measurement to a reference value; and

d) formulating a calibration value [from an adjustment of the output measurement against the reference value] based on the act c), such that during a subsequent generation of light output, the calibration value permits the subsequent light output to [approximate an output accorded to the reference value] have a calibrated intensity.

31. (Amended) A method as set forth in claim 30, further including storing the calibration value[, such that upon the subsequent generation of light output, the stored calibration value may be accessed to permit the subsequent light output to approximate an output accorded to the reference value].

34. (Amended) A method as set forth in claim [30] 33, wherein the step of formulating includes scaling the light output, such that the relative value approximates the reference value to permit generation of uniform light output by the LED.

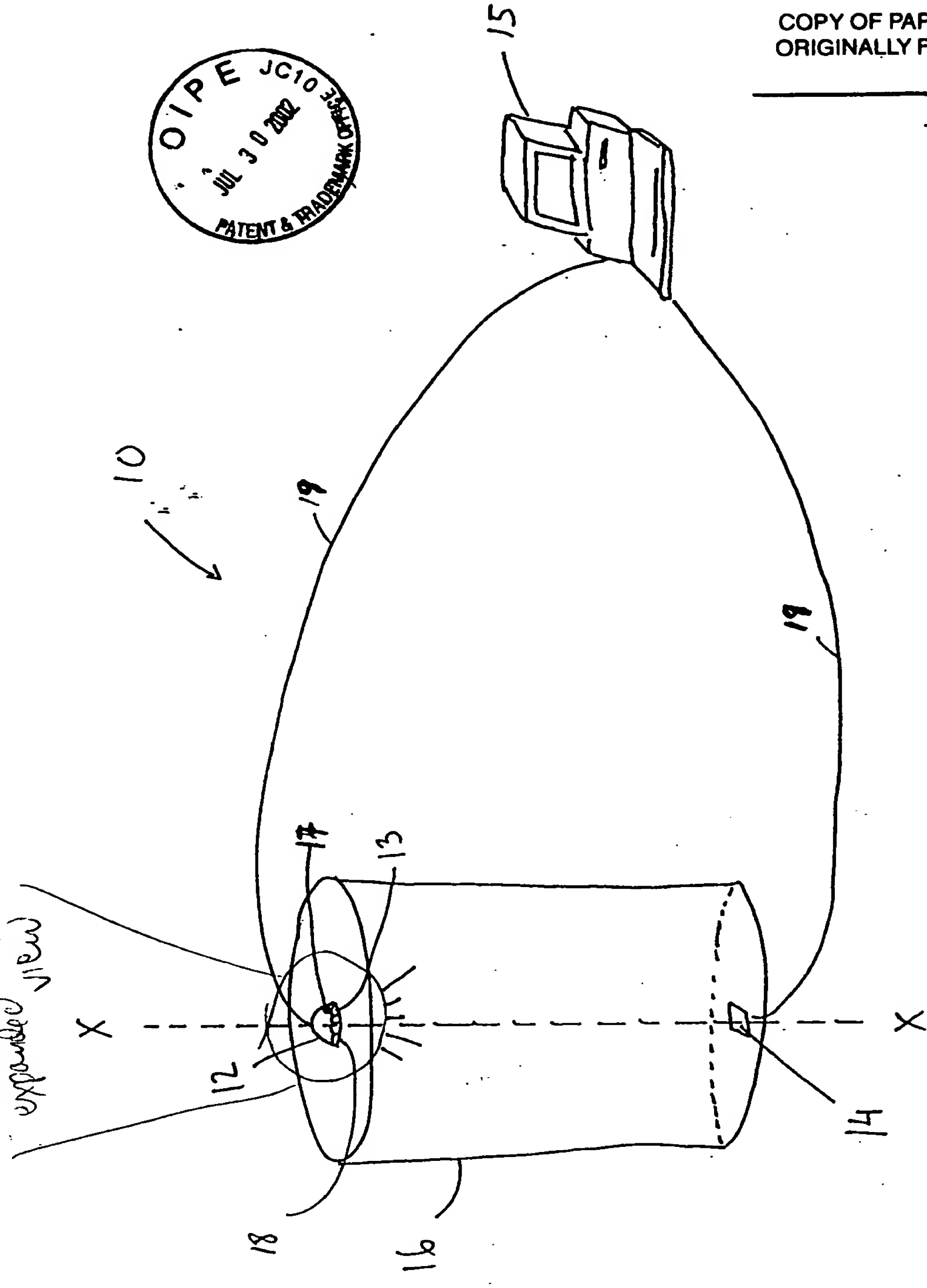

Fig. 1

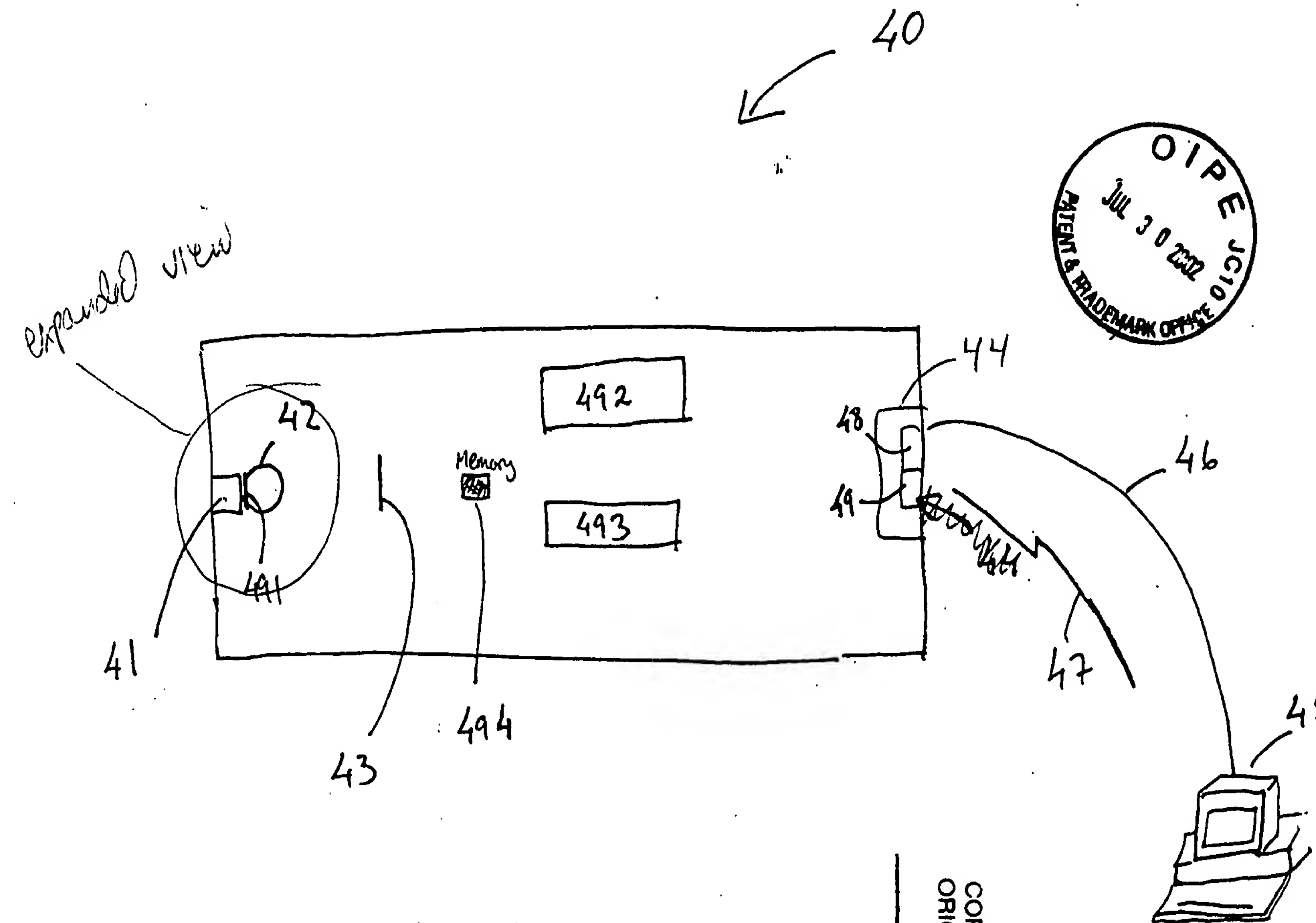
40
expanded view
42
491
41
43
Memory
494
492
493
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Fig.4

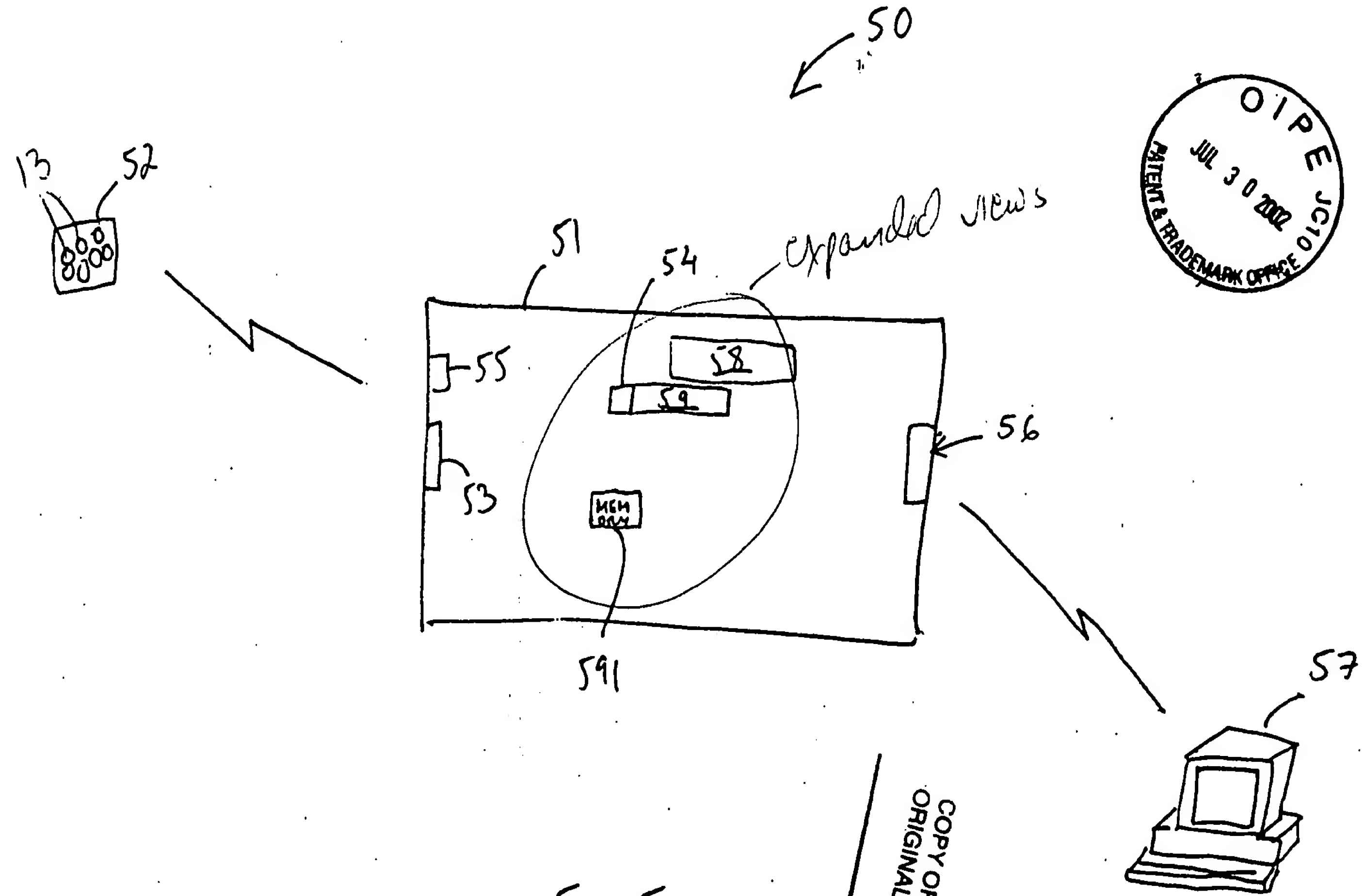


Fig. 5

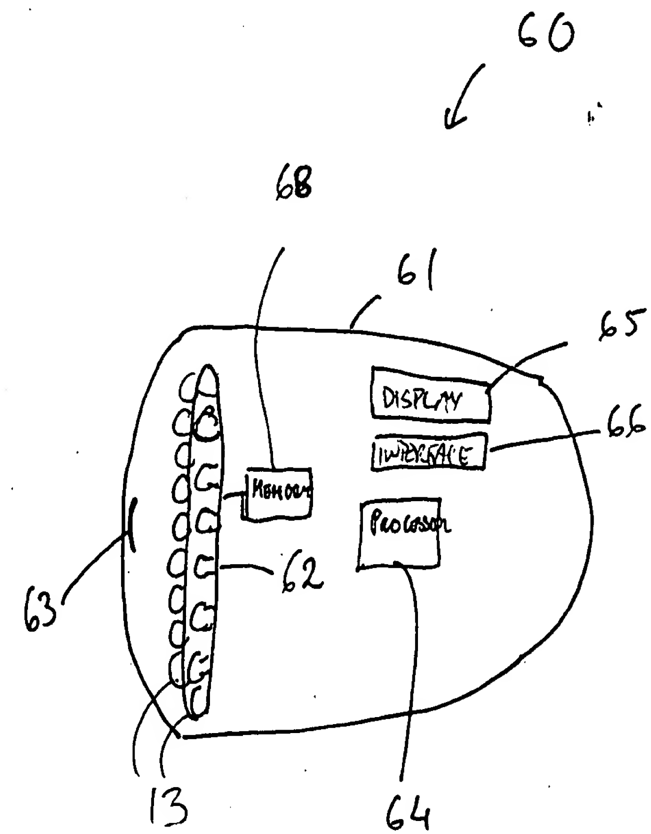


Fig. 6

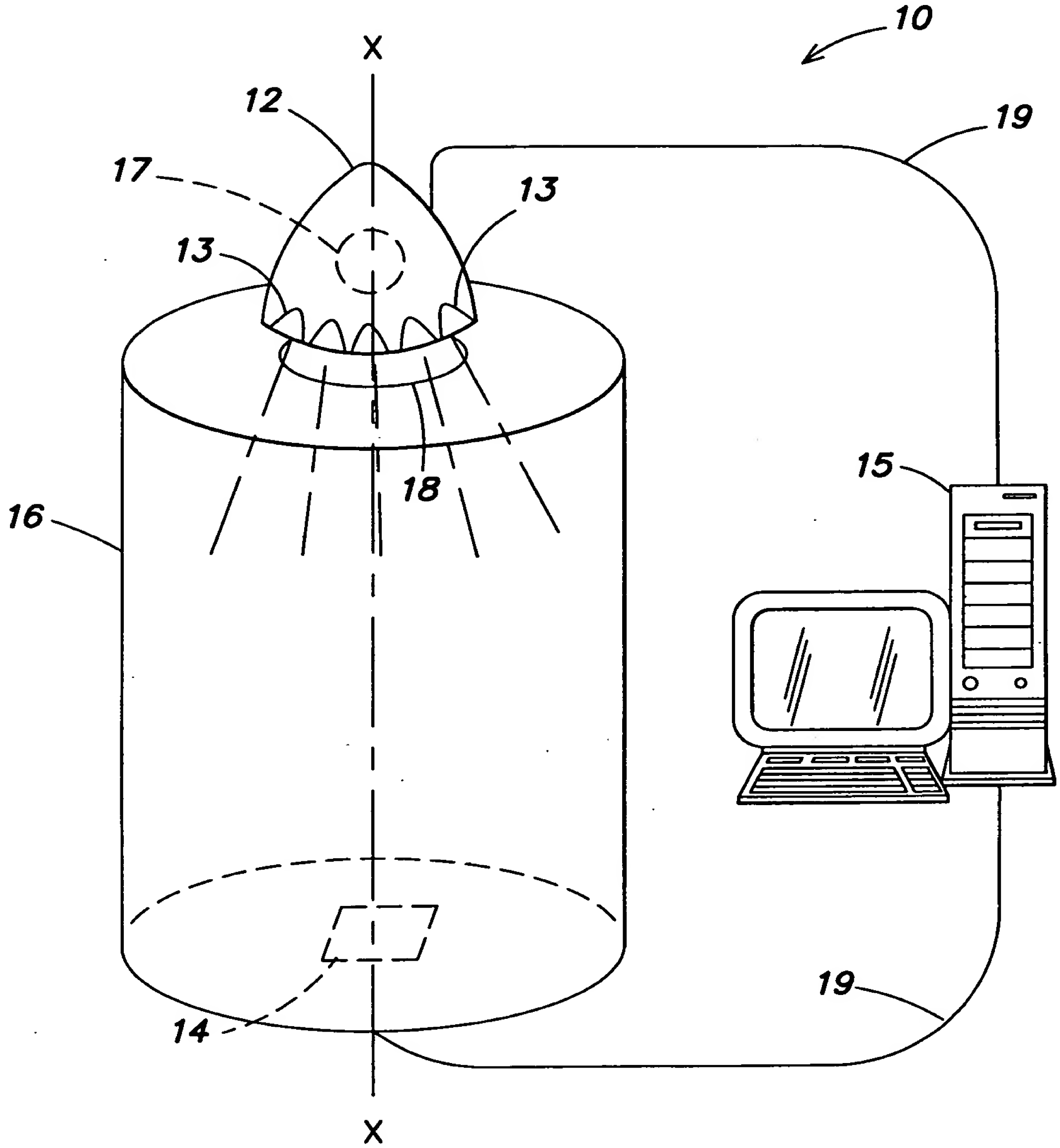


FIG. 1

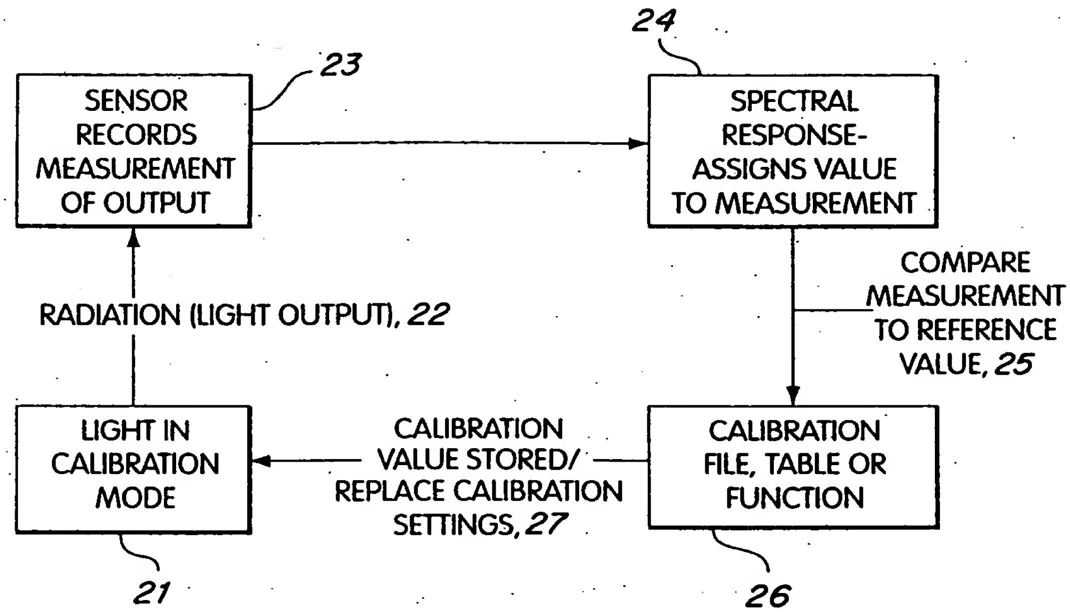
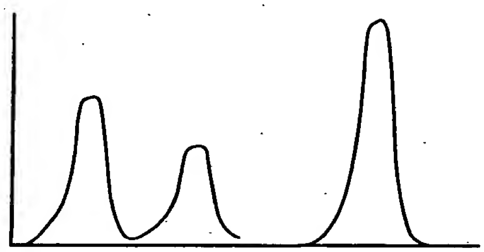
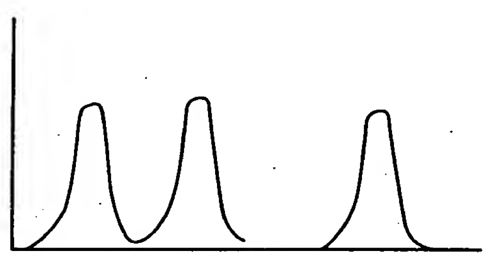

SENSOR RECORDS MEASUREMENT OF OUTPUT
23
SPECTRAL RESPONSE-ASSIGNS VALUE TO MEASUREMENT
24
RADIATION (LIGHT OUTPUT), 22
COMPARE MEASUREMENT TO REFERENCE VALUE, 25
LIGHT IN CALIBRATION MODE
CALIBRATION VALUE STORED/ REPLACE CALIBRATION SETTINGS, 27
CALIBRATION FILE, TABLE OR FUNCTION
21
26

FIG. 2



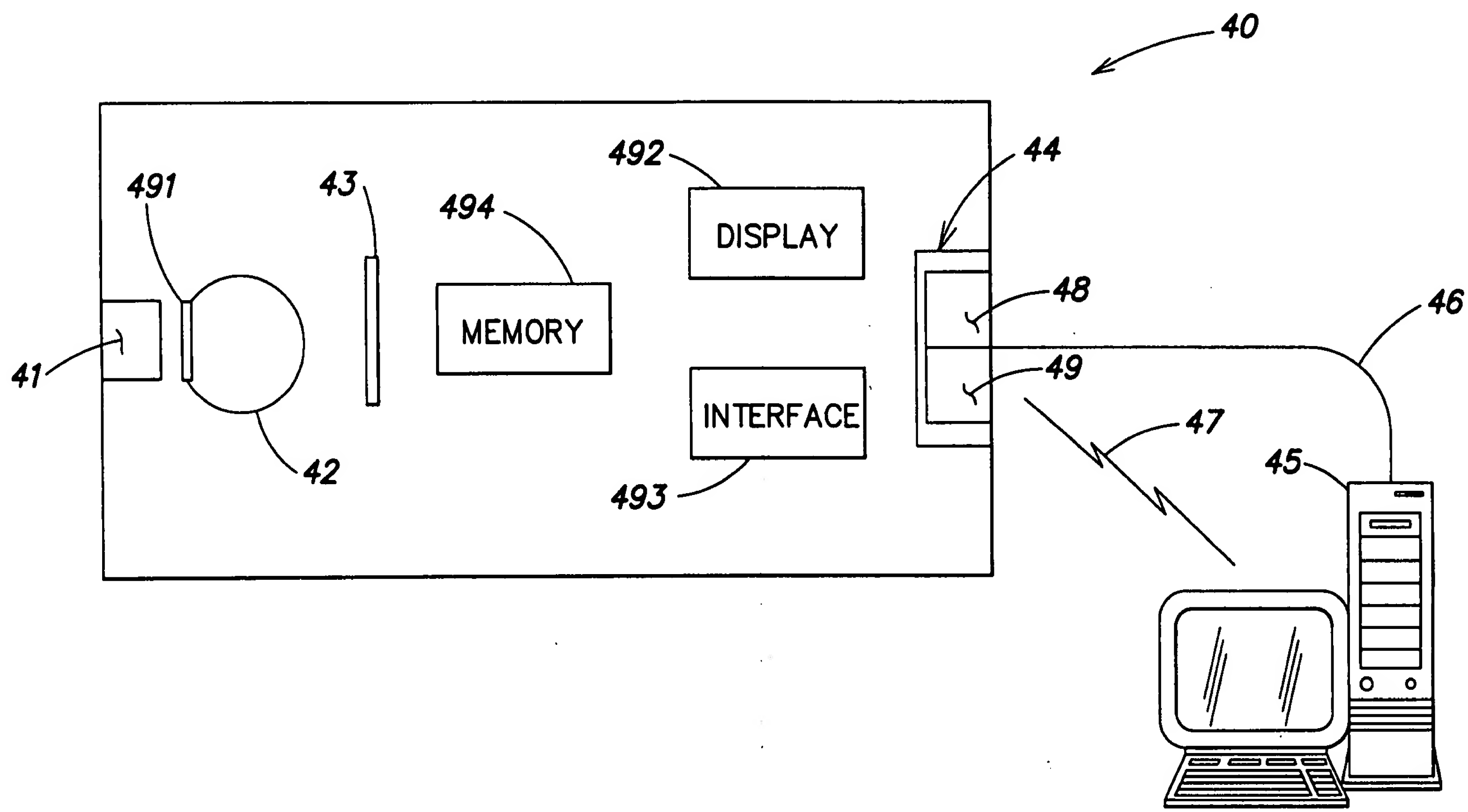
BEFORE CALIBRATION COLOR
PEAKS CAN RANGE WIDELY

FIG. 3A



AFTER CALIBRATION COLOR PEAKS
CAN BE SCALED APPROPRIATELY

FIG. 3B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494
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DISPLAY
MEMORY
INTERFACE
41
42
493

FIG. 4

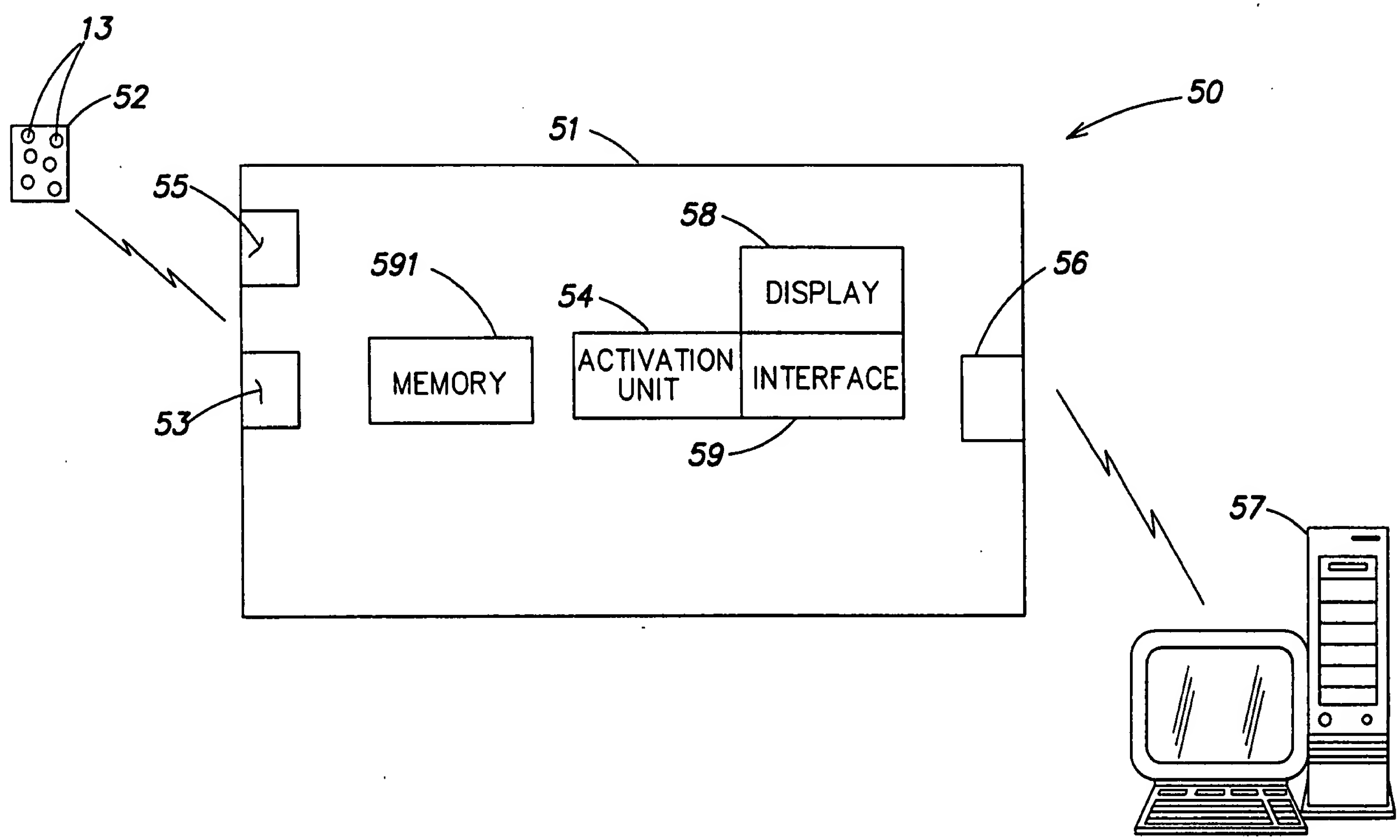
13
52
55
53
51
591
MEMORY
54
ACTIVATION UNIT
58
DISPLAY
INTERFACE
59
56
50
57

FIG. 5

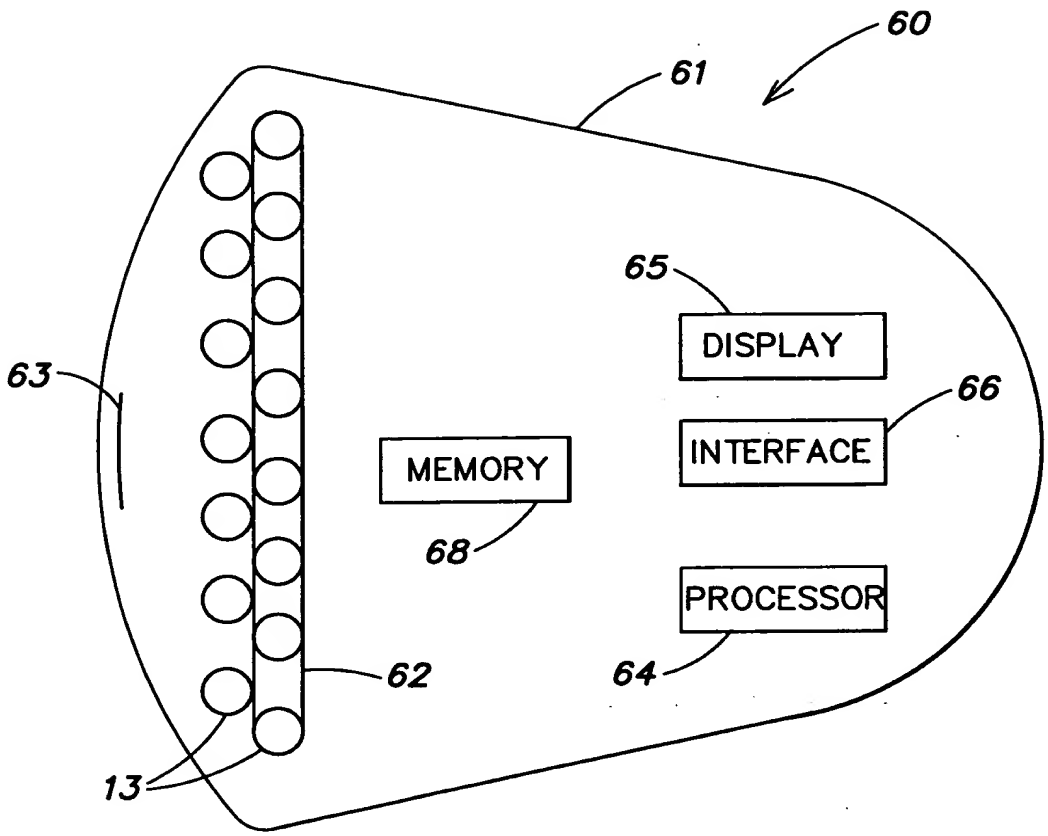

FIG. 6